



INDIANA DEPARTMENT OF TRANSPORTATION

INTER-DEPARTMENT COMMUNICATION

Standards Section Room N642

Writer's Direct Line

233-2273



May 14, 2001

DESIGN MEMORANDUM No. 01-02 POLICY CHANGE

TO: All Design, Operations, and District Personnel, and Consultants

FROM: /s/ Anthony L. Uremovich
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Technical Services Division

SUBJECT: Impact Attenuator Design and Contract Document Preparation Requirements

SUPERSEDES: Impact Attenuator References in Design Manual Chapter 49

EFFECTIVE: October 16, 2001, Letting

The policy relating to impact attenuators has been changed to adhere to the current AASHTO and FHWA accepted Test Level-1 (TL-1), Test Level-2 (TL-2) and Test Level-3 (TL-3).

1. The format for impact attenuator pay items is "Impact Attenuator, (Type), (Width), (Test Level)."
2. There are now five impact attenuator types. They are ED, R1, R2, CR, and LS.
3. There are three impact attenuator widths. They are W1, W2, and W3.
4. Impact attenuator designs shall be in accordance with TL-1, TL-2, and TL-3. The Type LS impact attenuator design shall be in accordance with TL-1 only.

Based on the above, "Impact Attenuator, R1, W1, TL-3" is an example of an impact attenuator pay item.

All contract document references to impact attenuators should be in the pay item format noted above.

Attached is an interim design procedure to replace Section 49-6.0 of the Design Manual. This interim procedure will remain in effect until superseded by an official Design Manual revision or another Design Memorandum / Policy Change document. In addition, Design Memorandum No. 01-02 Technical Advisory has been prepared to provide additional information regarding the design and contract document preparation procedures related to impact attenuators.

References to impact attenuators in other sections of the Design Manual are also superseded by this document. Designers are instructed to follow the attached interim procedure to verify impact attenuator warrants.

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INTERIM DESIGN MANUAL CHANGES

49-6.0 IMPACT ATTENUATORS

49-6.01 Types of Impact Attenuators

The Department uses five types of impact attenuators. They are as follows:

1. Type ED. Type ED impact attenuators are energy dissipation devices.
2. Type R1. Type R1 impact attenuators are energy dissipation devices that have redirective capability on one side.
3. Type R2. Type R2 impact attenuators are energy dissipation devices that have redirective capability on two sides.
4. Type CR. Type CR impact attenuators are also energy dissipation devices that have redirective capability on two sides. These attenuators are used at locations where there are lateral clearance restrictions that make installation and maintenance of the attenuator difficult.
5. Type LS. Type LS impact attenuators are low speed energy dissipation devices that have redirective capability on two sides. These attenuators shall be in accordance with Test Level 1(TL-1) criteria only.

49-6.02 Design

After the design of roadside barriers is performed in accordance with Section 49-5.0, it is necessary to determine whether there are any obstructions located within the clear zone that are not protected. Obstructions that can be protected by extending a proposed barrier a short distance should be protected in that manner. However, impact attenuators should be utilized to protect isolated obstructions.

Figure 49-6A illustrates common impact attenuator installations. The D1 dimension shown on the figure determines whether an attenuator is warranted and, if so, whether the attenuator requires redirective capability on the side adjacent to the traffic under consideration. The D2 dimension shown on the figure is used to determine whether the attenuator requires redirective capability on its backside.

For obstructions in gore or similar areas, the offset dimension from the edge of the obstruction face to the mainline outside travel lane edge must be compared to the similar measurement between the obstruction and the ramp inside travel lane edge. The smaller of the two offsets is defined to be D1 and the larger offset is considered to be D2.

The attenuator type is determined by using Figure 49-6B. The attenuator selection design is based on the appropriate test level for the project design speed of the roadway under consideration. Attenuator Type LS should be selected for a design speed of 50 km/h or lower and the attenuator design should be in accordance with TL-1 criteria. Attenuators for higher design speeds should be in accordance with TL-2 or TL-3 criteria. If the design speed is 70 km/h or less, the attenuator design should be in accordance with TL-2 criteria. A project with a design speed of greater than 70 km/h will require an attenuator design which should be in accordance with TL-3 criteria. Attenuators shielding obstructions located between roadway facilities with different design speeds (e.g. in gore areas) should be in accordance with the Test Level requirement for the higher design speed.

The required attenuator width designation is based on the width of the obstruction. There are three standard widths available. They are as follows:

1. W1. This attenuator width is required for obstructions that are not more than 900 mm wide.
2. W2. This attenuator width is required for obstructions that are more than 900 mm wide but less than or equal to 1800 mm wide.
3. W3. This attenuator width is required for obstructions that are more than 1800 mm wide but less than or equal to 2400 mm wide.

The Type ED impact attenuator is limited to the W1 width only. Width requirements greater than W1 will necessitate the selection of a Type R1 or a Type R2 impact attenuator.

The Type LS impact attenuator is limited to the W1 width only, and shall be in accordance with TL-1 criteria. Width requirements greater than W1 will necessitate the selection of a Type R2 or a Type CR impact attenuator which should be in accordance with TL-2 criteria.

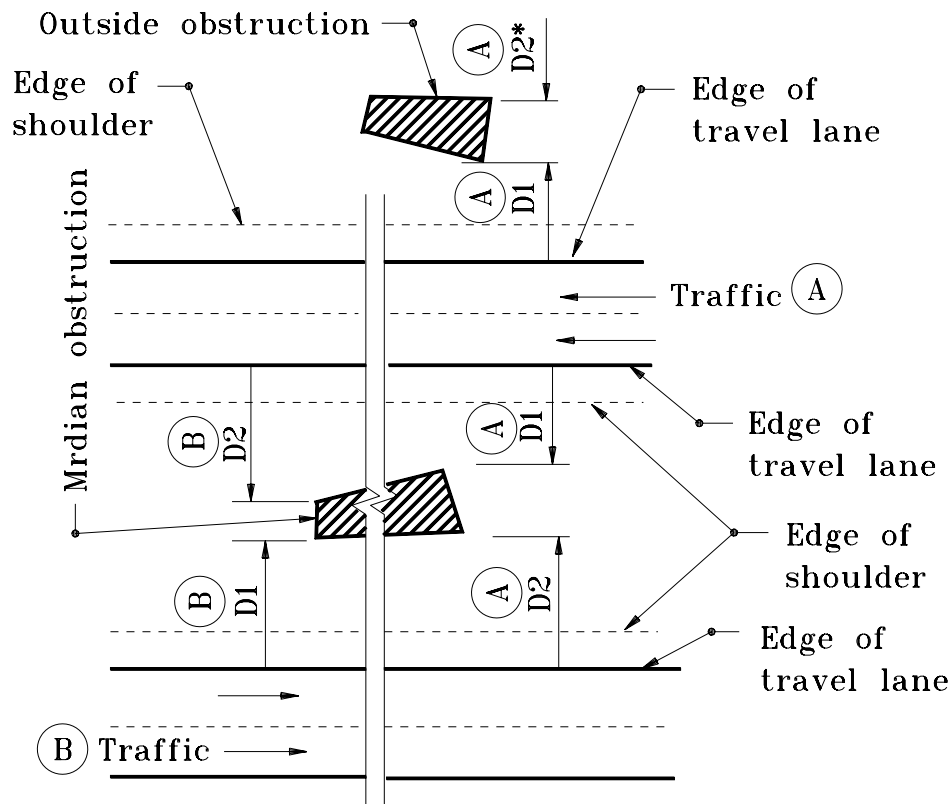
For all other impact attenuator types, if the obstruction width is greater than 2400 mm, the obstruction should be shielded by a special attenuator design, altered so the width is less than or equal to 2400 mm, or moved to a location where shielding is not required.

Figure 49-6C illustrates the space requirements for approved impact attenuators. On roadways with a shoulder section, the attenuator footprint shown on the figure should not encroach onto the usable shoulder, as defined in Chapters 53, 54, and 55, as appropriate. On roadways with curbs, the attenuator footprint should not encroach onto the 0.5 m appurtenance-free zone, as discussed in Section 49-2.0. If the roadway section includes a sidewalk, the attenuator footprint should not encroach upon the sidewalk to reduce the remaining sidewalk width to less than 1.2 m. If the attenuator footprint violates any of the above encroachment limits, the obstruction should be shielded with a roadside barrier, altered so the footprint encroachment is satisfactory, or moved to a location where shielding is not required.

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Attachments

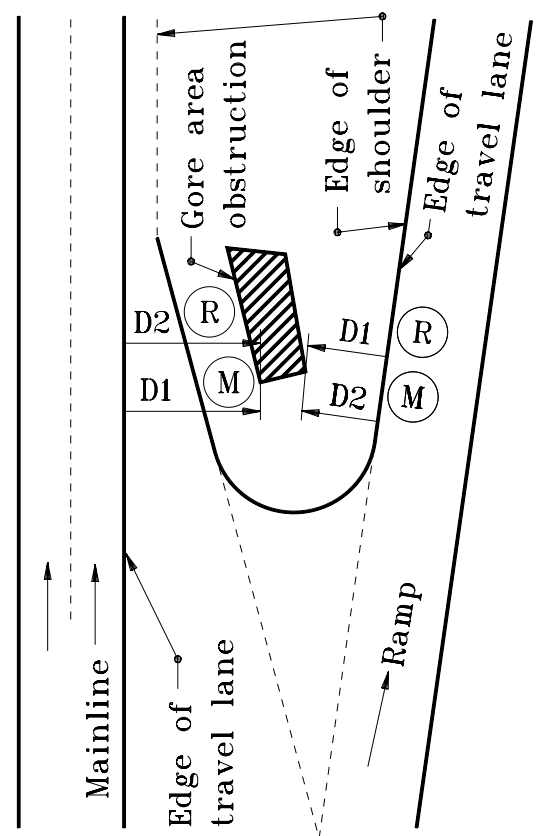
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* For an outside obstruction with no pavement located to the outside of the obstruction, $D2$ is defined to be greater than 15 m.

MULTI-LANE DIVIDED FACILITY OFFSETS

IMPACT ATTENUATOR OFFSET EXAMPLES



Use smaller of $D1$ values

(M) Mainline

(R) Ramp

GORE AREA OFFSETS

Figure 49-6A

	Test Level 3 (TL-3)	Test Level 2 (TL-2)	Test Level 1 (TL-1)
Attenuator Type	Offset Dimensions D1 & D2 (If Applicable)	Offset Dimensions D1 & D2 (If Applicable)	Offset Dimensions D1 & D2 (If Applicable)
ED	* $7.6 \text{ m} \leq D1 \leq 15 \text{ m}$ $7.6 \text{ m} \leq D2 \leq 15 \text{ m}$	* $D1 = 7.6 \text{ m}$ $D2 = 7.6 \text{ m}$	N/A
R1	$3.0 \text{ m} < D1 \leq 15 \text{ m}$ $D2 > 15 \text{ m}$	$3.0 \text{ m} < D1 \leq 7.6 \text{ m}$ $D2 > 7.6 \text{ m}$	N/A
R2	$3.0 \text{ m} < D1 < 7.6 \text{ m}$ $D2 \leq 15 \text{ m}$	$3.0 \text{ m} < D1 < 7.6 \text{ m}$ $D2 \leq 7.6 \text{ m}$	N/A
CR	$D1 \leq 3.0 \text{ m}$	$D1 \leq 3.0 \text{ m}$	N/A
LS	N/A	N/A	$D1 \leq 5.5 \text{ m}$
None Required	$D1 > 15 \text{ m}$	$D1 > 7.6 \text{ m}$	$D1 > 5.5 \text{ m}$

Offset dimensions D1 and D2 are based upon clear zone requirements. See Section 49-6.02 and Figure 49-6A for additional information regarding D1 and D2.

D1 = Offset dimension from edge of obstruction face to edge of travel lane in the direction of travel under consideration.

D2 = Offset dimension from edge of obstruction face to edge of travel lane on opposite side of the obstruction, if applicable.

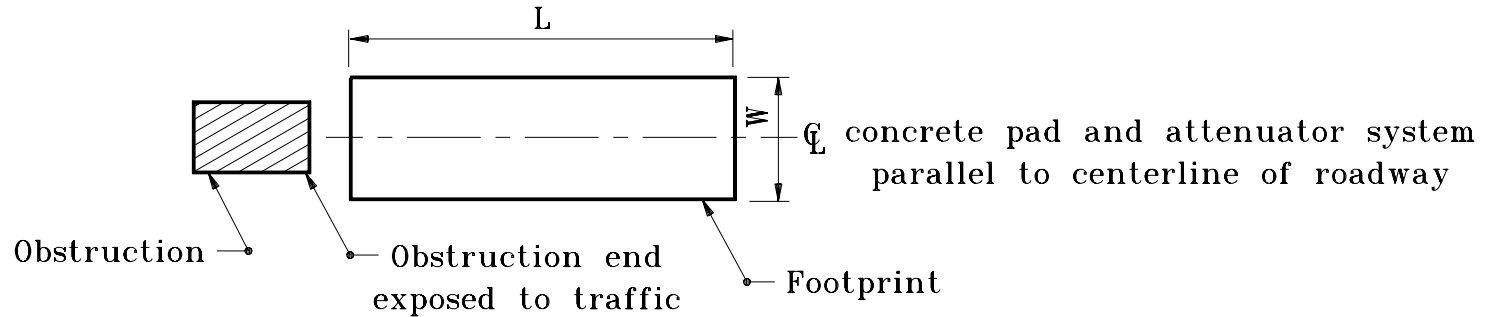
* The required offset dimension D1 ($\geq 7.6 \text{ m}$) is for installation of impact attenuator Type ED, gravel barrel array only.

IMPACT ATTENUATOR TYPE DETERMINATION

Figure 49-6B

NOTES:

1. The table shows approximate footprint of the required space, including pad, for the impact attenuator system.
2. Non-mountable curbs should not be used in front of impact attenuator.



(Type of attenuator)/ Width designation	Required impact attenuator system space, in m Footprint: Length (L) x Width (W)		
	Test Level-3 (TL-3)	Test Level-2 (TL-2)	Test Level-1 (TL-1)
(ED)/W1	14.5 x 6.0	9.0 x 5.0	N/A
(R1,R2,CR)/W1	11.0 x 1.4	5.5 x 1.4	N/A
(R1,R2,CR)/W2	11.0 x 2.6	5.5 x 2.6	N/A
(R1,R2,CR)/W3	11.0 x 3.1	5.5 x 3.1	N/A
(LS)/W1	N/A	N/A	3.10 x 1.25

IMPACT ATTENUATOR FOOTPRINT REQUIREMENTS

Figure 49-6C